The Critical Investigation on Esensial Parameters to Optimize the Gas Lift Performance In "J" Field Using Prosper Modelling

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Abstract

The declining reservoir, oil production and pressure depletion in the well being produced will impact to the results of the decrease of investment value. In order to improve the performance of the well, it is requiresd to add energy that can help to lift the fluid to the surface. One of the artificial lift methods that can be used is a gas lift. Gas lift is a method commonly used when there is a natural gas source as an injection gas supply. The selection of the artificial lift method is based on several considerations, namely the reservoir conditions, fluid conditions, well conditions, conditions on the surface, availability of electricity, availability of gas, and sand problem. The influential parameters in the selection of gas lifts include Productivity Index (PI), Gas Liquid Ratio (GLR), depth of the well and driving mechanism from the reservoir. The Gas Lift that the production optimization wants to do is the injection system in a Continuous Gas Lift. Used in wells that have a high Productifity Index value. Where in the LB field to be analyzed, the Productifity Index value is 2.0 bpd / psi. This study intends to optimize a gaslift well performance as an effort to maximize the results of well production. Based on the research that has been done using Prosper Modeling on the "J" field, the following conclusions are obtained the effect of pressure and viscosity on the gas lift well flow rate in this condition can be said to be efficient, because the conditions / pressure given at temperatures below 300 F can reach the miscible condition and from the results of determining the optimal conditions to get the best well performance, obtain an optimal liquid rate of 1829.4 STB / D with an oil rate of 36.6 STB / D.

Keywords: Gas lift, Optimization, Immiscible Pressure, Viscosity

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INTRODUCTION

The declining reservoir, oil production and pressure depletion with the well being produced, the results of the investment of the well will also decrease. For that there needs to be energy that can help to lift the fluid to the surface.

One of the artificial lift methods that can be used is a gas lift. Gas lift is a method commonly used when there is a natural gas source as an injection gas supply. The selection of the artificial lift method is based on several considerations, namely the reservoir conditions, fluid conditions, well conditions, conditions on the surface, availability of electricity, availability of gas, and so on. The gas lift method has advantages compared to the pump method, if the well there is a problem of sand production and deep production wells. Gas lifts are carried out by injecting gas into the well both continuously and periodically to help drain the fluid from the well to the surface. (Terotos, I.E, 2015 P. 30).

There are two types of gas lift injection systems, namely continuous flow gas lifts and intermittent flow gas lifts. The continuous gas lift is used for wells that have high PIs, where the PI is high (> 0.5 B / D / psi) and the basic static pressure of the well is high (fluid column height is a minimum of 70% of the well depth). GLR limits for continuous gas lift applications up to 2000 scf / bbl. While the intermittent gas lift is used for wells that have a low PI value. (Terotos, I.E, 2015 P. 30).

Optimization of well production is an effort to maximize the results of well production, both from well performance and economically. Considering the increasingly limited sources of gas produced from production wells for gas injection, efforts to increase production are carried out by maximizing the rate of gas injection and injection pressure for lift gas wells (Sulistyanto, 2016).

The well which having high GLR and PI values, the gas lift method used is continuous scheme. The advantages of the continuous gas lift method can produce more than the intermittent gas lift method.

The objective of the optimization study of gas lift production is to determine the optimum immiscible pressure and viscosity by using prosper modeling to improve the performance gas lift.

The fluid lifts up in the tubing on the gas lift by using a high pressure gas that is injected into the well (through an injection valve) and helps lift it. The fluid lifted from the bottom of the well to the surface due to the impulse of high pressure gas through the injection valve, the fluid in the tubing (above the operating valve) becomes lighter, because of its lower density, lower viscosity, the ratio between gas and liquid (GLR, GOR) more large compared to reservoir fluid, the pressure loss is smaller so that the fluid can flow to the surface. The optimum amount of gas that is injected into the well through an injection valve is something that needs to be considered, because if the gas injected exceeds the optimum limit, the production rate will not increase, but on the contrary there will be a decrease in production (Musnal & Fitrianti, 2017). The expected end result in this gas lift well will be an increase in well performance which is marked by an increase in oil production rate and an optimum production rate of the gas lift well can be determined.

BASIC THEORY

The main thing that must be considered when producing oil wells is to determine how much flow rate can be obtained based on reservoir pressure. The resulting flow rate will illustrate the magnitude of the deliverability of a productive formation. Fluid found in porous media can flow to the wellbore if there is a pressure difference. Reservoir deliverability also affects the type of complexity and the artificial lift method used (Guo & William, 2007).

Inflow Performance Relationship (IPR) is used to evaluate reservoir deliveries in production techniques. Furthermore, the IPR curve is a presentation of the relationship between the pressure of the bottom well that flows and the rate of liquid production (Ariadji & Regina, 2001). At the multiphase Inflow Performance Rate (IPR), it is assumed that there is no skin in the formation and it has a mechanism to drive the water drive in the reservoir.

Vertical Lift Performance (VLP) is the ability of a well to produce a constant surface pressure limit. In flowing wells, this is called tubing intake or outflow performance (Sibeudu, S.O, 2015). The fluid flow in this tubing is a simultaneous flow of free gas and liquid, both of which can be mixed homogeneously or liquid in the form of slug which is driven by a gas column.

Gas lift is a process of lifting the well fluid to the surface by injecting gas through the annular tubing-casing under certain pressure and temperature conditions (Ebrahimi, 2010). The main purpose of a well is to do a gas lift injection to get the expected production rate through a decrease in the fluid flow pressure gradient in the tubing.

The nature of this liquid indicates its resistance to flow. This is an important property used in equations and flow processes. This is a dynamic property because it can only be measured if the fluid moves. Viscosity is a number that represents the force of attraction caused by the pulling force in the adjacent liquid layer. This can be considered as internal friction between molecules, separated from the liquid and the pipe of wall.
The term interface indicates a boundary or line dividing between two immiscible phases. The types of interfaces include: liquid-gas, liquid-liquid, liquid-solid, solid-gas and solid-solid. For fluids, molecular interactions at the interface produce measurable voltages which, if constant, are proportional to the surface free energy needed to form the interface area unit. For cases where the liquid is in contact with air or steam from the liquid, the force per unit length is needed to form a surface area commonly referred to as surface tension. Interfacial tension is used to describe the quantity of two liquid or liquid solids. Interfacial tension between two immiscible liquids is usually smaller than the surface tension liquid with a higher voltage and often intermediate between the surface tension of two liquids (W. Lyons, 2010).

METHODOLOGY

The research methodology is carried out as follows; data collection, several analysis is required such as the number active gas field well and performance status of the field, identifying the gas lift well flow rate in immiscible and miscible pressure is reached, analyzing the effect of the maximum pressure parameter related to the viscosity value of the fluid in the well prior miscible condition touched. And finally, determining optimum conditions to get the best well performance.

CASE STUDY

The J- Field is situated in the NW Java Basin in the onshore, eastern part of the J-Sub-basin, Indonesia (see figure 1). It was discovered in 1969 and began production in 1975. The oilfield contains several minor Miocene-Pliocene oil and gas pools but the bulk of the oil is contained in a broad tilted fault-block in which folded and fractured volcanics of the Eocene-Oligocene. J- Formation form the main reservoir. Post-depositional movement of bounding faults suggests the trap was not completely formed until the Plio-Pleistocene. The reservoir comprises two productive layers of subaerial and fluvially reworked tuffs separated by a layer of non-productive, highly weathered basaltic/andesitic lava Fractures are essential for commercial production and they mostly occur in the crestal areas of the field where folding has been most intense. The fractures are more effective in the more compact tuffs than in the clay dominated lavas, which have porosities of up to 9% but no effective permeability. Due to the fractures, the tuffs, regionally, have porosities and permeability of up to 25% and ~10 D, respectively. Volcanic facies identification is done by combining data core, cutting and data log. The results of these analyzes were obtained 4 facies as Table-1 mentioned.

Jatibarang structure is one of the surface producing oil and natural gas in the level II district of Indramayu Regency. Geographically, the Jatibarang structure is located in the Northwest of the city of Cirebon with a distance of about 40 km or about 20 km to the North from the Randegan oil and gas field.

The total initial oil reserves in the Jatibarang-Volcanic structur (OOIP) area are around 436.9 MMSTB (volumetric OOIP risk-static model S1-S4) and the main target in Volcanic S3 is 416.45 MMSTB. Since being produced from 1971 to 2015, Jatibarang field has 169 wells consisting of 62 active production wells (30 volcanic production wells), 29 injector wells (6 injection wells in volcanic) and 78 wells are suspended or abandoned.

The Jatibarang structure has a productive layer in volcanic and the layers in the Cibulakan formation where JAtibarang volcanic is the main oil production source. Jatibarang volcanic is devided into 4 rock reservoir cycles namely Tuff S1, Tuff S2, Tuff S3 and Tuff S4 with the main reservoir is Tuff S3.

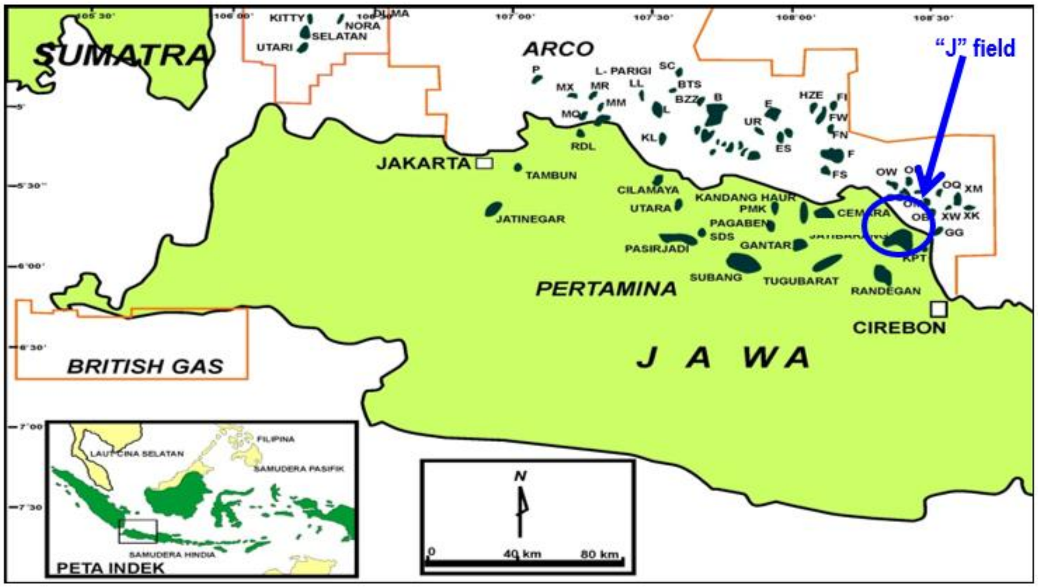

Figure 1. Jatibarang Field location in West Java map

RESULT AND DISCUSSION

Data from J-field (see figure 2 & 3) show the specific reservoir and fluids data either from field or lab. Those data was utilized to find the desire result.

WELL	DJT_212					Date :	10 Oktober 2018
Lapisan	2227-2296						
DATA INPUT							
Tek. Jaringan Gas	800 psi	S.G. Killing Fluid	1.010	Surface Temp.	155 F		
Tek. Well Head	90 psi	Grad. Flowing	0.081 psi/ft	BHT	282 F		
Top Perforasi	2227.0 meter	GOR Formasi	3,000 scf/bbl	Water Cut	98 %		
Bottom Perforasi	2296.0 meter	Grad. Res Fluid	0.433 psi/ft	GLR Total	500 scf/bbl		
Pressure Drop Casing Pressure antar Valve Gaslift	30 psi	Pressure Drop Across Valve	50 psi				
WELL PRODUCTIVITY							
Well Static Pressure	1955 psi						
Well Flowing Press	1091 psi						
Q @ Pwf	1041 bfpd						

Note : **Input Data in Yellow Cell Only**

Figure 2 Production Reservoir Data

No.	Data	Value	Unit
1	Average Reservoir Pressure (Pws)	1955	psi
2	Productivity Index (PI)	1.2	bpd/psi
3	Formation Temperature (Tbh)	282	deg.F
4	Water Content (KA)	98	%
5	Specific Gravity of water formation	1.01	
6	Specific Gravity of Gas (SGg)	0.7	
7	Gas Injection (Qinj)	0.6	MMscfd
8	Gas Injection Pressure (Psurf) .	56.25	Ksc
9	Wellhead Pressure (Pwh)	90	Psi
10	Tubing size (Dt)	2-7/8	inchi
11	KSB type	Camco-J20	

Figure 3 Reservoir Fluid Data

Identification of Pressure and Viscosity

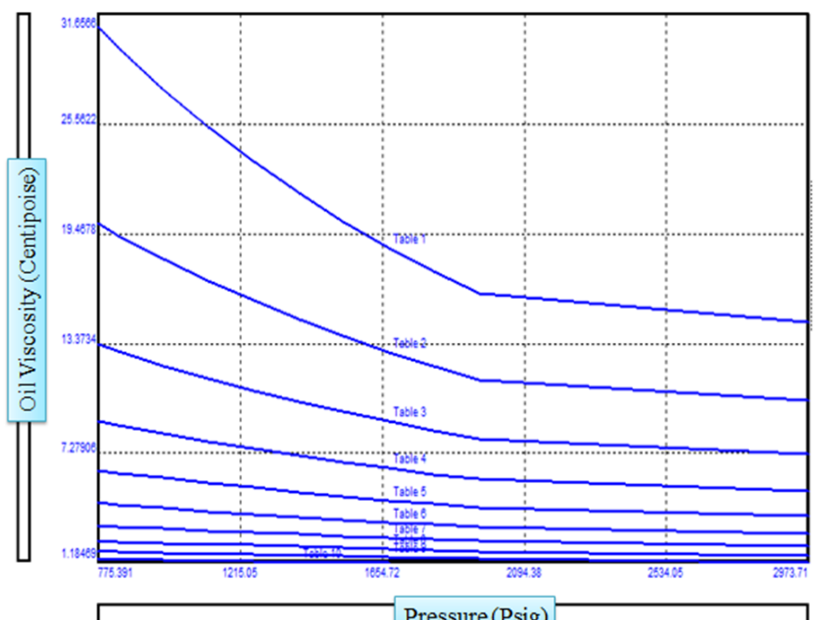

Figure 4 PVT Lookup Table Using Prosper Modelling

Figure 4 is obtained using the IPM-Prosper Production simulator by inputting data in the IPM-Prosper production simulator.The first step is to input the well PVT data to get the value from the graph of oil viscosity and pressure. The PVT data is very useful to explain how special a reservoir characteristic, neither formation nor fluids and their reaction to the external stimulant.

The picture 4 exhibits the relationship between pressures on viscosity at each temperature that will be examined in immiscible pressure conditions and after being miscible at the J #36 well using prosper modeling. The viscosity of oil is very dependent on pressure and temperature. Oil viscosity decreases while the pressure and temperature increase. It will decrease significantly in the miscible pressure. From the picture 4, it can be seen that the decreasing in viscosity, which considerably fast during immiscible pressure period, but once the miscible condition reach, the decrease of the oil viscosity value slightly change thru the pressure relationship. This can happen because the gas slowly starts to dissolve in liquid. And when the viscosity value drops drastically, this condition indicates that the viscosity has reached the miscible point which means that two different characteristics of the substance begin to fuse. The occurrence of mixing two substances before and after reaching the miscible condition is due to the influence of the pressure and temperature values. The pressure and temperature relationship is directly proportional, but oppositely to the fluid viscosity.

Conclusively, the pressure alteration will impact severely to oil viscosity during immiscible phase. It means the best condition of gas lift performance is just before the miscible phase. Once, the fluid attends to miscible phase, insignificantly, pressure will impact to the oil viscosity.

Determining Optimal Conditions to Get Well Performance

In this second chapter, optimization will be carried out to determine the optimal condition of the oil well obtained in well J#36 by using prosper modeling with two different pressure comparisons.

After doing a pressure parameter analysis of viscosity for the well flow rate in the previous section, the optimization of the J # 36 well is conducted to achieve the best well performance which is considered the most optimal. Modeling the actual conditions of production wells is the first thing done in each production optimization. Modeling is done by building an IPR (Inflow Performance Relationship) and VLP (Vertical Lift Performance) curves for subject wells. The IPR curve is the flow from the reservoir to the wellbore or a curve which shows the reservoir flow behavior into the wellbore while the VLP curve is a curve that exhibits the flow behavior from the bottom wellbore to the surface.

In this study, the VLP curve was built using the Beggs and Brill method[3]. The method is considered appropriate to be applied because the correlation is best suited to the conditions on the well in the field “J” which relatively have some gas lift well with high GOR.

In this research, optimization was carried out by doing a sensitivity of the gas rate versus the oil rate. This optimization also included several assumptions from the sensitivity of the well head pressure by adjusting the well head pressure on the gas lift (see figure 5, 6 & 7).

After the IPR (Inflow Performance Relationship) curve is obtained in the previous sub-chapter, then combination of the IPR & VLP calculation system is carried out. This is conducted for the determination of oil optimization obtained with a continuous gas lift system. Optimization is also done by reducing the pressure on vertical lift performance. The following are the optimization results that have been made from the modeling made between the IPR vs. VLP curves to get the best well performance.

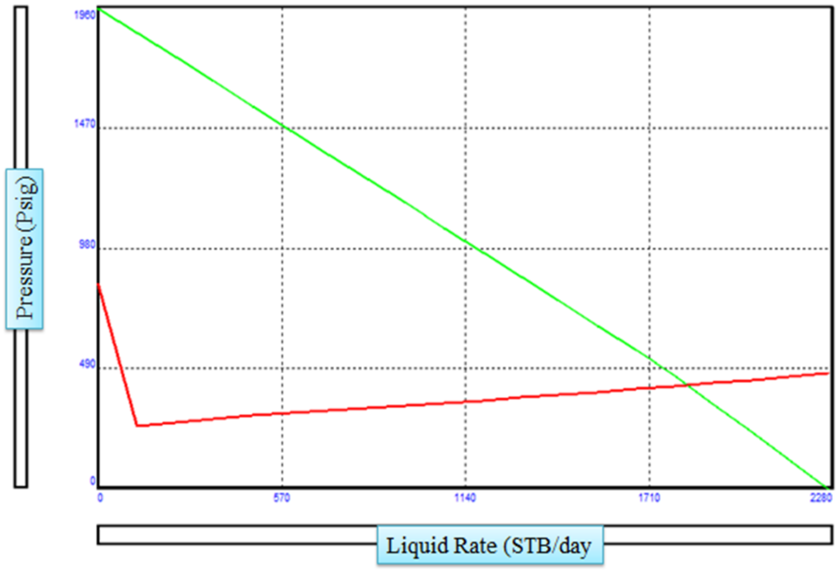

Figure 5. IPR vs. VLP curve with Pwh 100 psi

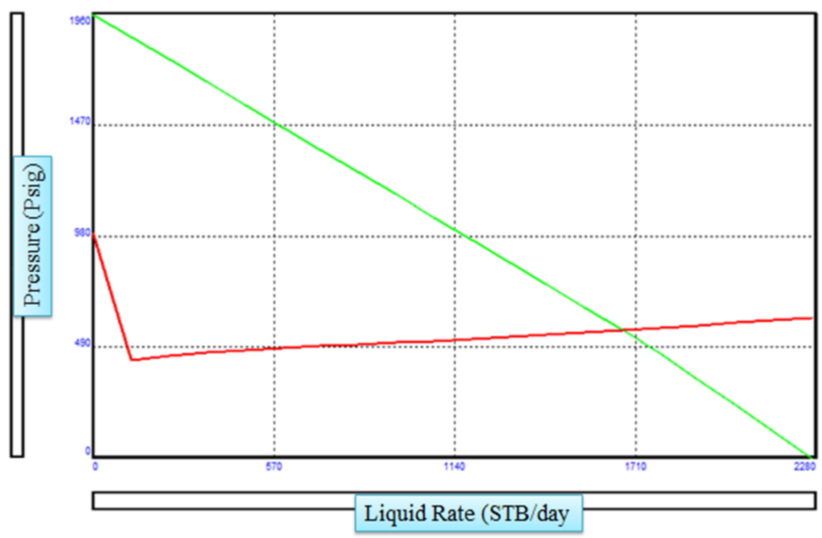

Figure 6. IPR vs. VLP curve with Pwh 246 psi

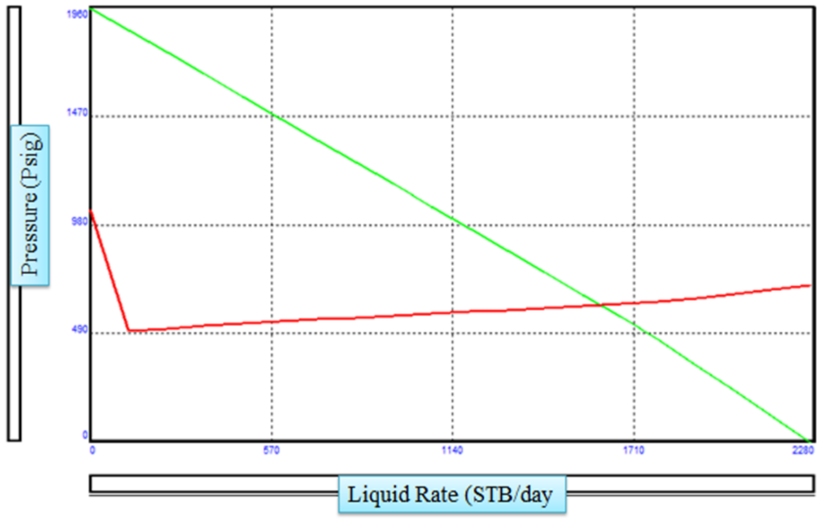

Figure 7. IPR vs. VLP curve with Pwh 300 psi

Figure 2 show the data and input results to build IPR vs. VLP curves, where from the intersection of these curves we will get the optimum flow rate and selected among the three curves above which is the most optimum to get the best well performance. Wellhead pressure is a parameter that affects the amount of liquid rate. In this study it was found that, the greater the wellhead pressure the smaller the optimum liquid rate obtained and vice versa if the smaller the wellhead pressure then the rate of liquid is even greater. Evidently the relationship is quite between wellhead pressure and liquid rate.
Data from the company, the controllable wellhead pressure are 100, 246 & 300 Psi. These obtains a different value of liquid rate in each wellhead pressure setting (see table 1).

Table 1 Results of intersection of IPR vs VLP curves

Figure	Well Head (Pwh)	Liquid Rate (STB/D)	Oil Rate
3	100 Psi	1829.4	36.6
4	246 Psi	1669.1	33.4
5	300 Psi	1604.3	32.1

Based on the results of the intersection of the curves shown in the figures and tables above, it can be summarized the optimal conditions for obtaining the best well performance from the wellhead pressure and liquid rate. The reducing wellhead pressure significantly can bring a significant number of liquid rate. Pwh reduction up to 150 psi can bring 150 bbls. Reservoir model used in this study is vogel method. It should yield a curve of second power equation, but it looks like the curve tends linier then non linier

CONCLUSION

1. The last immiscible pressure gives the best effect in oil viscosity on the gas lift well system.
2. The results graph determine the optimal conditions to get the best well performance, which is following a linier line and obtain an “optimal” liquid rate of 1669 STB / D with an oil rate of 33.4 STB / D for Pwh 246 psi.

RECOMMENDATION

1. It is recommended to conduct more detail investigation in gas lift performance by utilizing vogel method, either manual or simulation, and then compare them to have a wide perspective of “J” field fas lift system.
2. Investigate the gas processing system which is one of the important parameter of the performance of gas lift well

ACKNOWLEDGEMENT

Thanks for PT.Pertamina Asset 3 and Panji Laborta Chemindo that have an excellent collaboration in this study with the Islamic University of Riau.

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